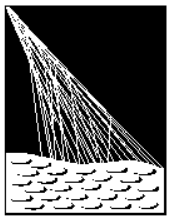


The Pierre Auger Project

Capturing Messengers from the Extreme Universe

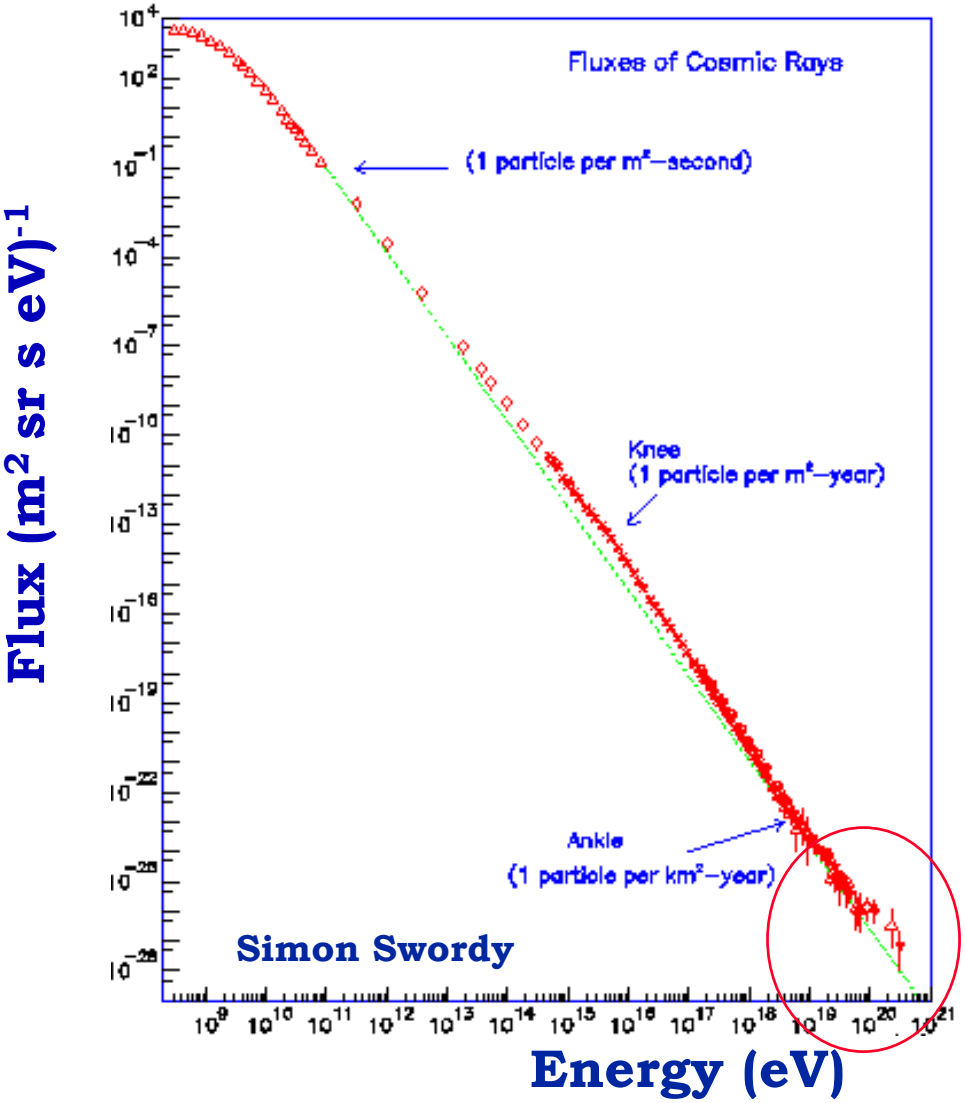
A progress report

P. Mantsch

27 March 2003

PIERRE AUGER OBSERVATORY

Cosmic Ray Spectrum



Over the past 40 years ~15 events with ➢10^{20} eV

Highest energy event: 3.2 x 10^{20} eV Fly's Eye in Utah in 1991

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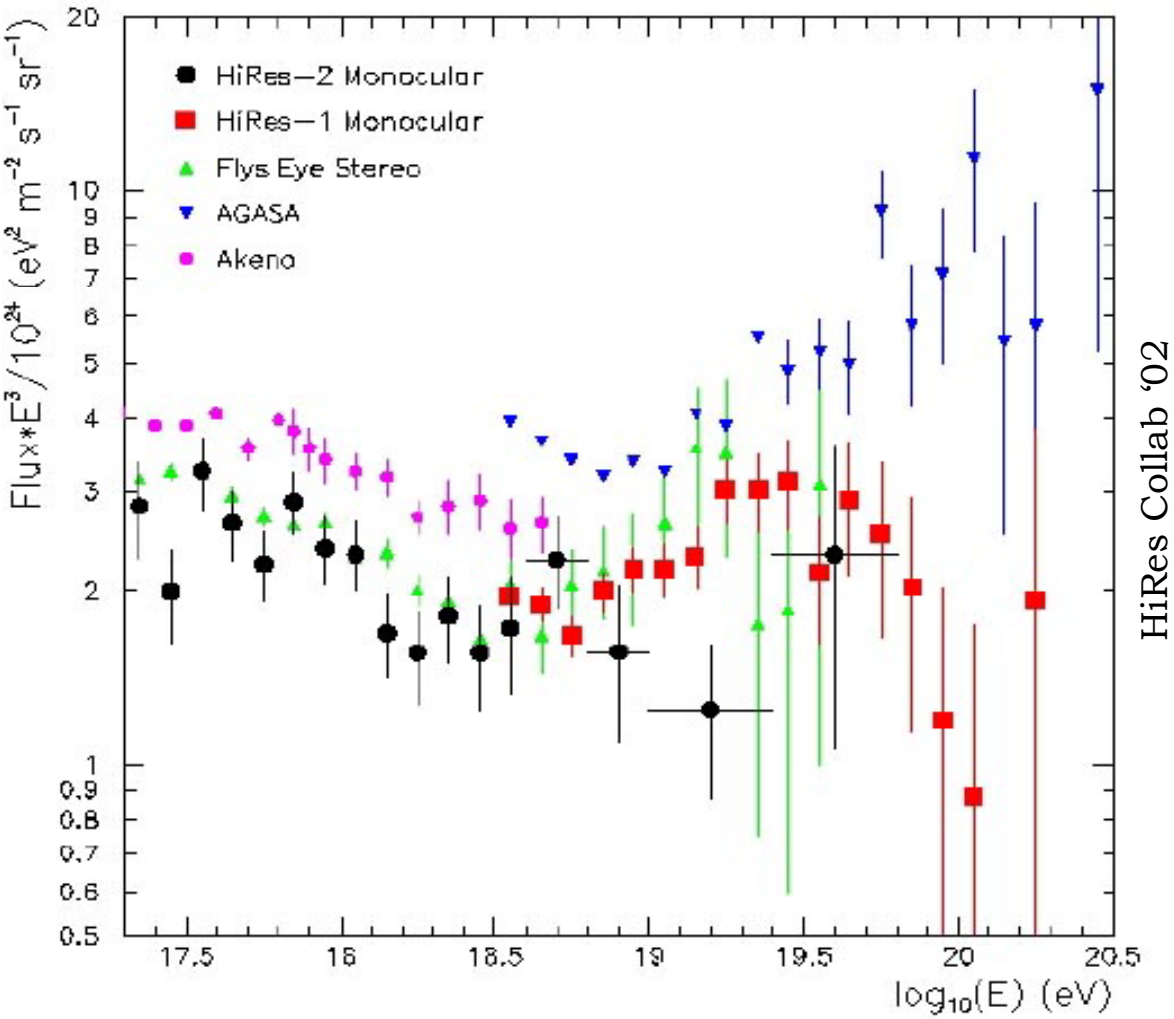
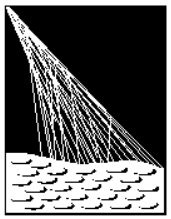
Cosmic Ray Data at the highest energies



HiRes Collab '02



Possible Sources

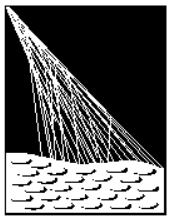
Conventional – Bottoms-Up

- **Hot spots in radio galaxy lobes?**
- **Accretion shocks in active galactic nuclei?**
- **Colliding galaxies?**
- **Associated with gamma ray bursts?**

Exotic – Top-Down

- **Annihilation of topological defects?**
- **Wimpzillas – heavy dark matter?**
- **Z bursts?**

New physics?



The Pierre Auger Project

A High Statistics Study of

The Highest Energy Cosmic Rays

$>10^{19}$ eV

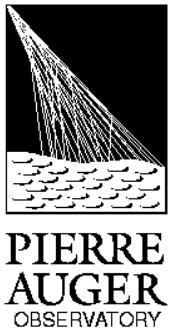
Energy Spectrum - Direction – Composition

Two Large Air Shower Detectors

Argentina (under construction)

USA

Collaboration: 15 Countries/50 institutions



The Auger Collaboration

Argentina
Australia
Brazil
Czech Republic
France
Germany
Greece
Italy
Mexico
Poland
Slovenia
Spain
United Kingdom
USA
Vietnam

50 Institutions, >250 Scientists

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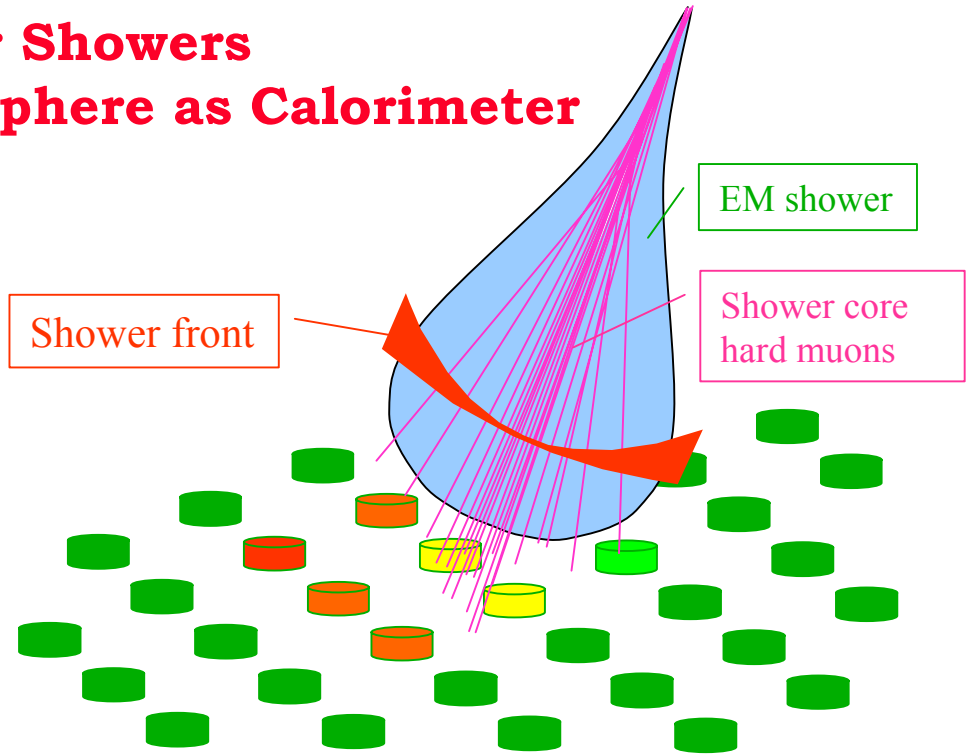
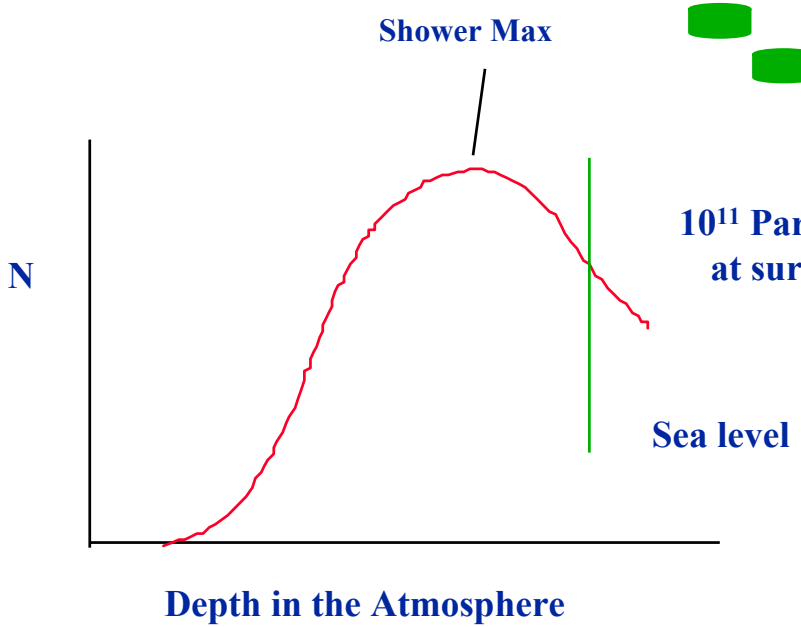
Air Showers and the Atmosphere as Calorimeter





10^{11} Particles at surface

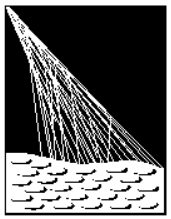
Sea level

$\gamma \sim 89\%$

$e^{\pm} \sim 10\%$

} 10 MeV

$\mu \sim 1\%$ 1 GeV



Air Shower Detector Techniques And their features

Particle Detector Array

- 100% duty cycle
- Uniform sky coverage
- Simple robust detectors
- Mass determination using rise time, muon/em
- Energy determination depends on simulation

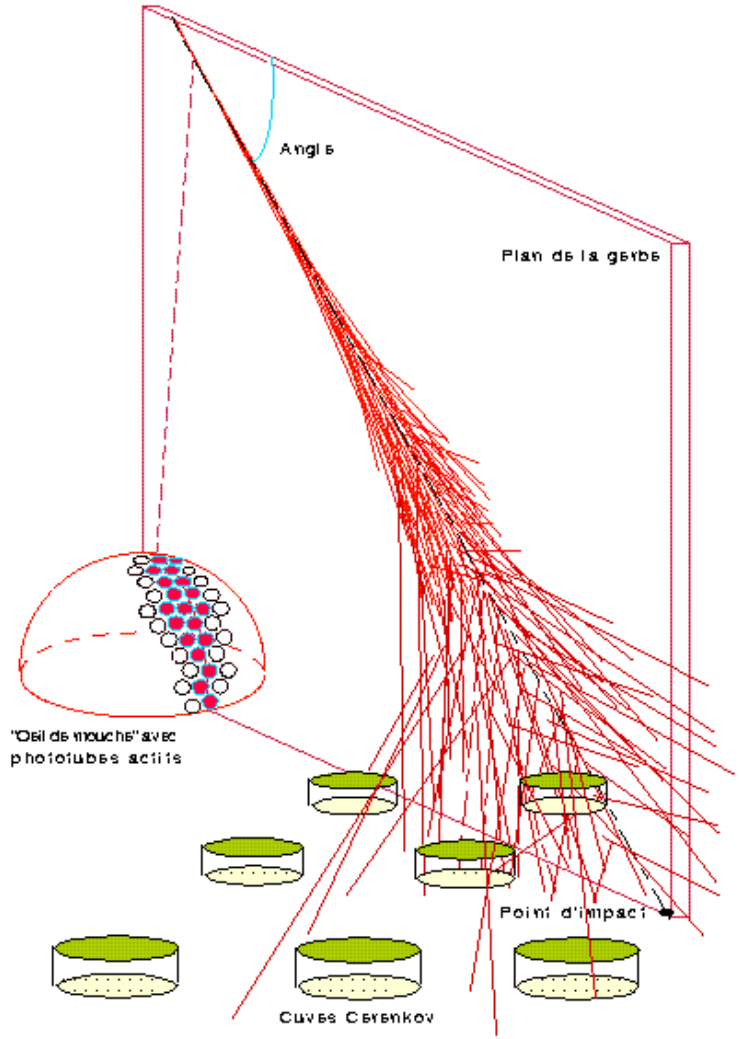
Fluorescence Detector

- Calorimetric energy measurement
- Direct view of shower development
- Good angular resolution (< 1°)
- Need correction for atmospheric attenuation
- 10% Duty factor

Pierre Auger Observatory

Combines strengths of

Surface Detector Array and Fluorescence Detectors



Hybrid detector:

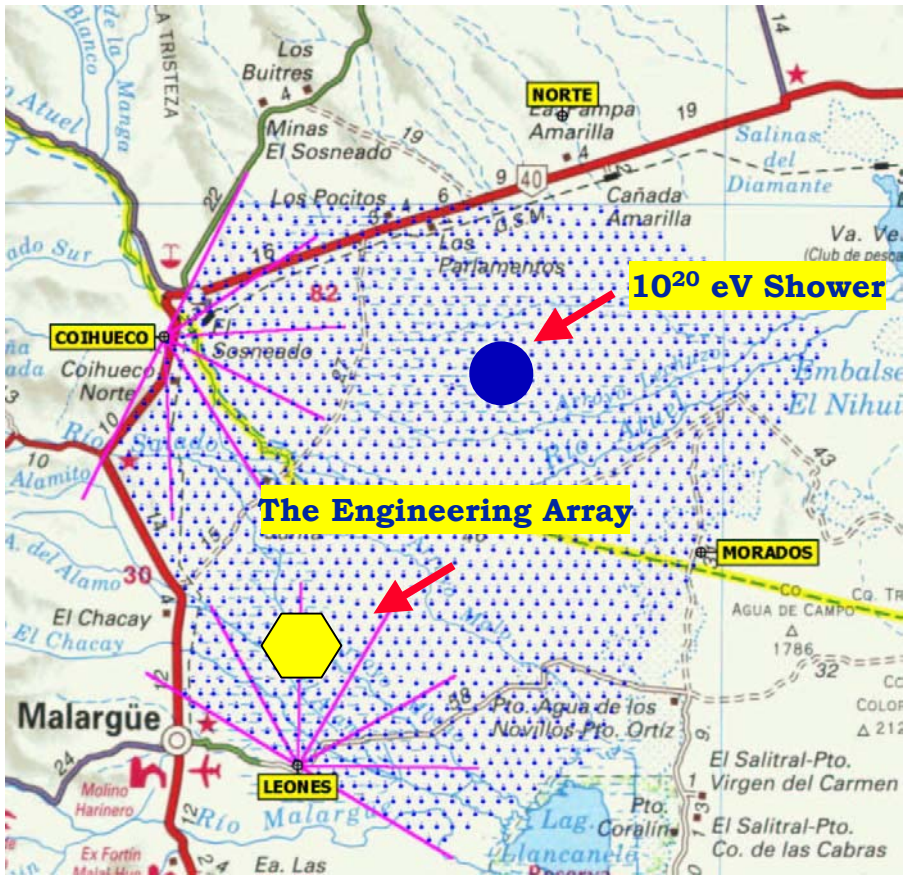
- Independent measurement techniques allow cross calibration and control of systematics
- More reliable energy and angle measurement
- Primary mass measured in complementary ways
- Uniform sky coverage

Auger Observatory
Southern Site

PIERRE AUGER OBSERVATORY

1600 Detector Stations
1.5 Km spacing.
7000 km² str

24 fluorescence telescopes
in four enclosures



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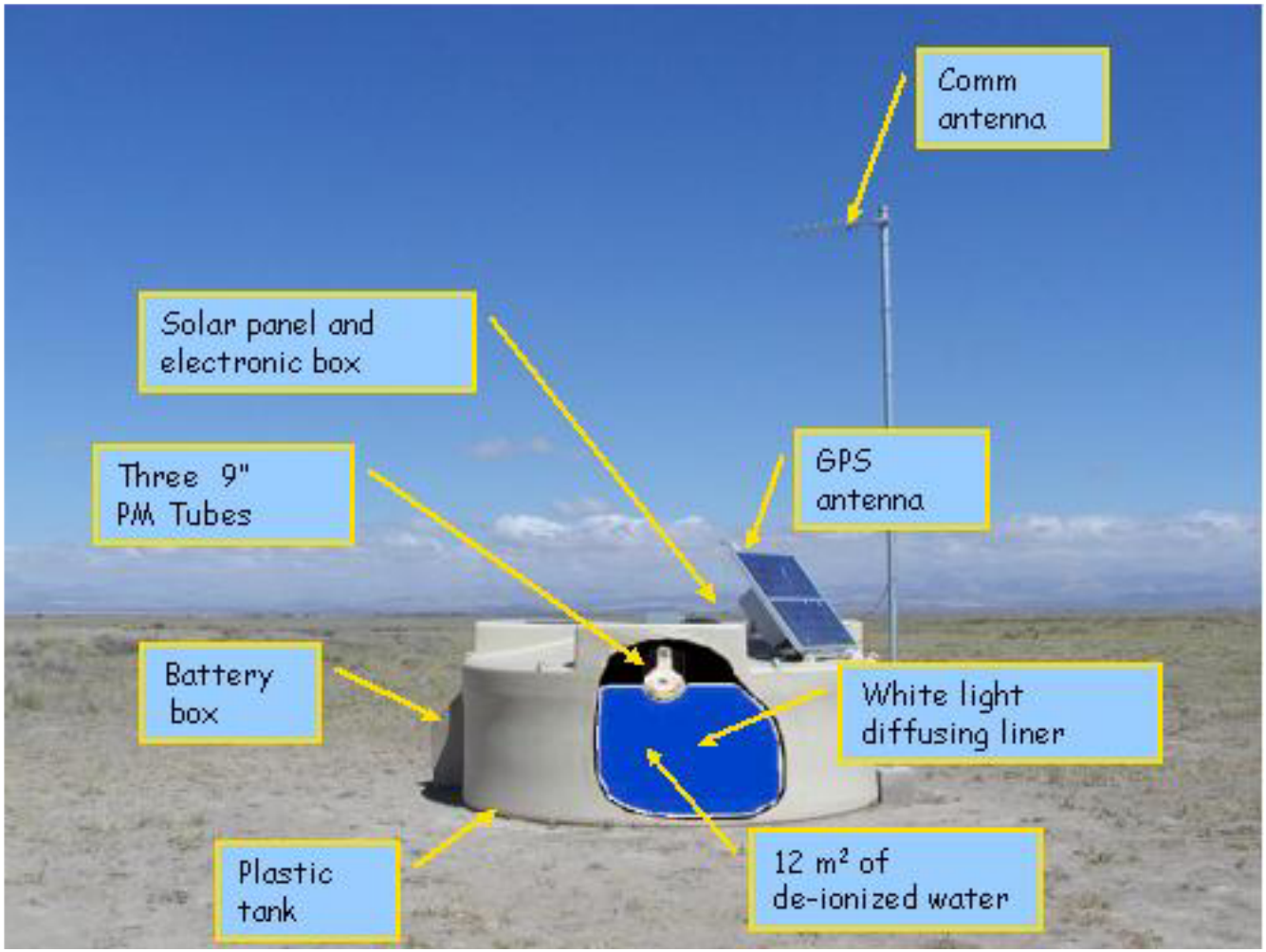
The Auger Surface Detector



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Surface Detector Station with curious local residents

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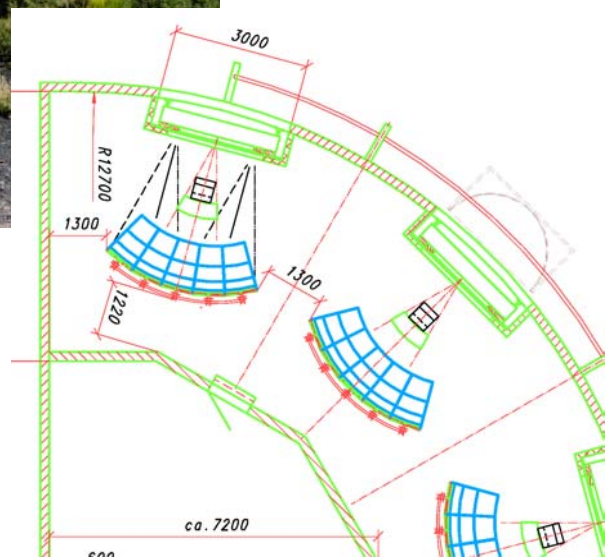
Fluorescence Detector Building at Los Leones



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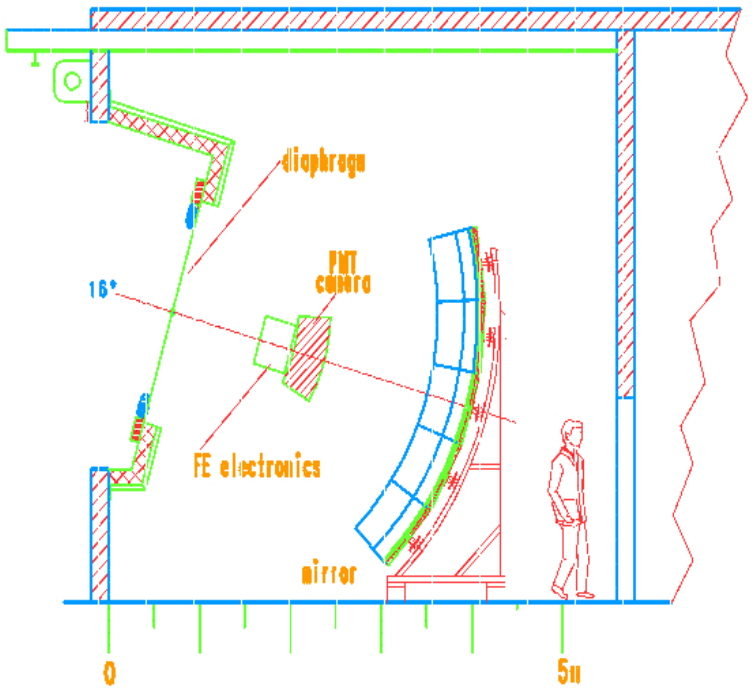
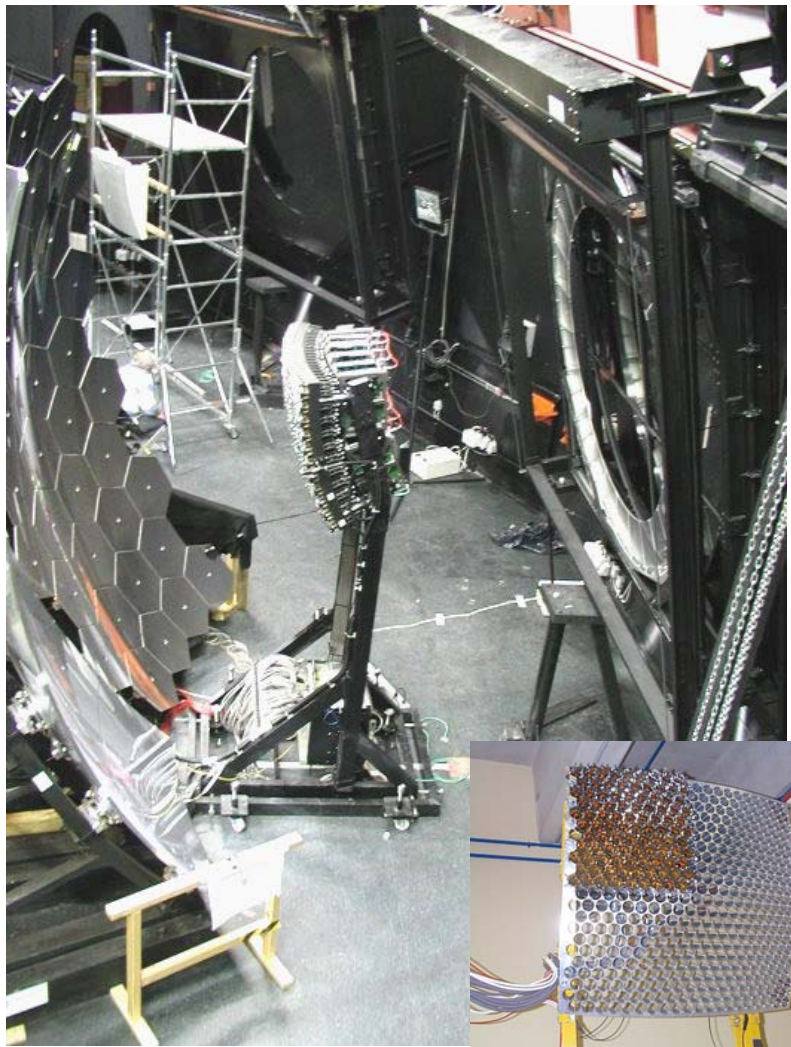
Auger Fluorescence Detector

24 telescope units
3.4 meter dia. Mirrors
440 PMTs per camera





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Fluorescence Building at Coihueco

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The Auger Campus

Detector Assembly Building

Cerenkov detector tanks being prepared for deployment

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Auger Center Building

PIERRE AUGER OBSERVATORY

Observatory Staff

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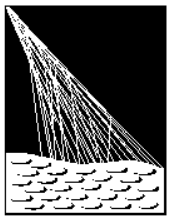
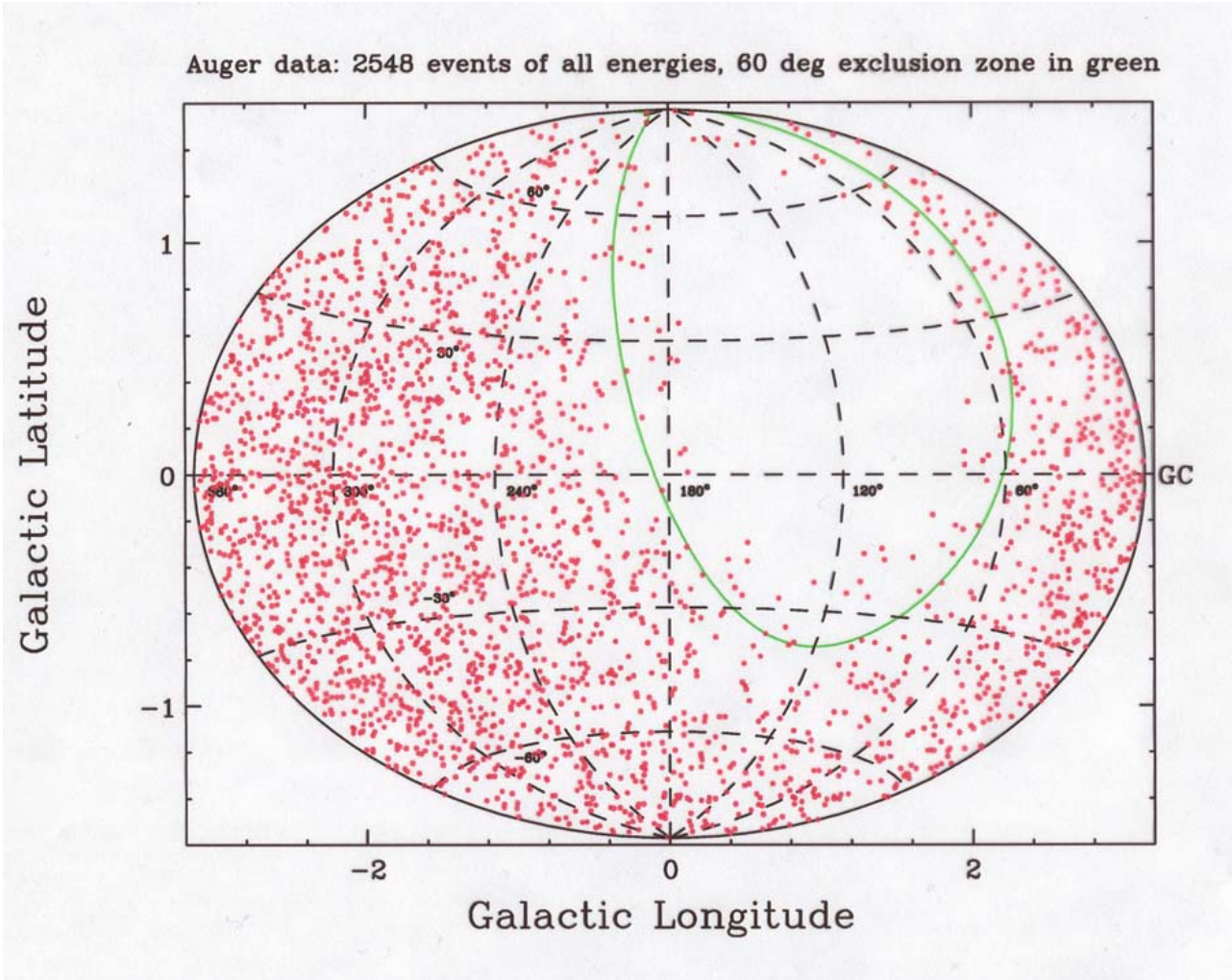


Observatory Construction Plan and Project Status

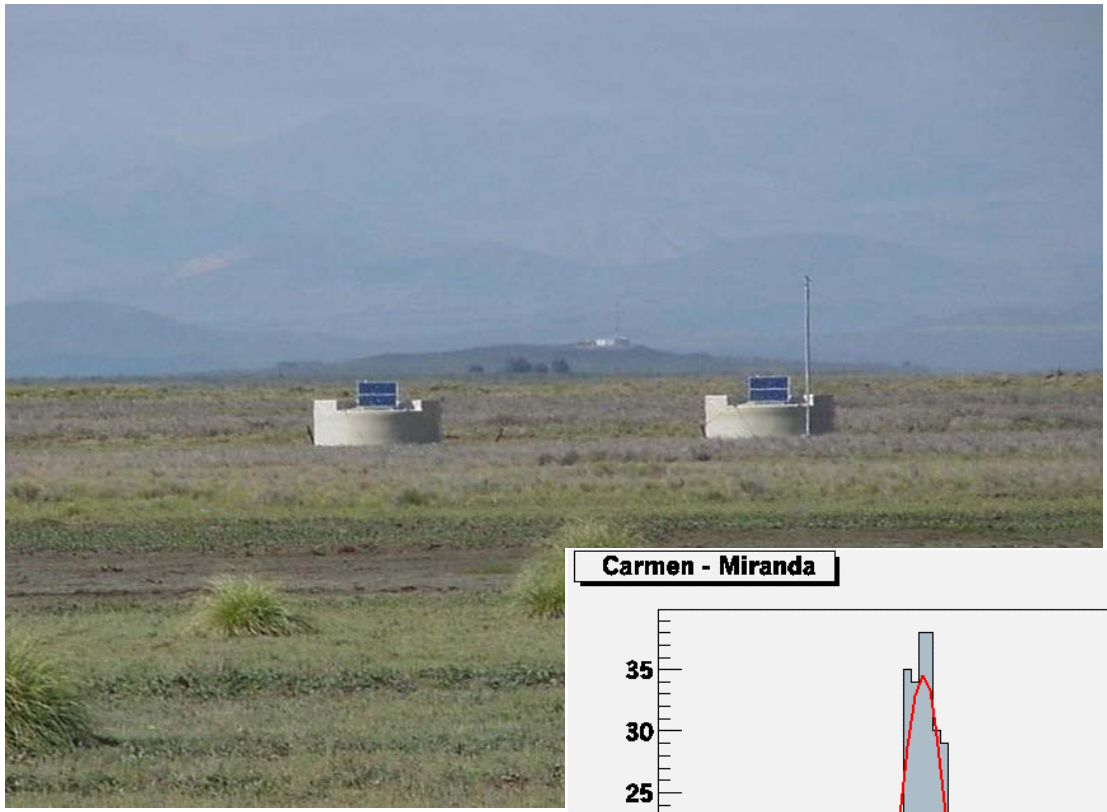
- **Engineering Array – two years -*complete***
  - **32 surface detector stations**
  - **2 fluorescence detector prototype telescopes**
  - **80 hybrid events**
  - **Surface array in operation for > one year**
- **Full Construction – three to four years – *underway***
  - **Designs refined based on experience with the engineering array.**
  - **Pre-production of 100 sets of surface detector components nearly complete.**
  - **Deployment of pre-production detector stations underway – 46 tanks deployed.**
  - **Two (of four) fluorescence buildings complete – installation of the first 12 telescopes underway.**

PIERRE AUGER OBSERVATORY

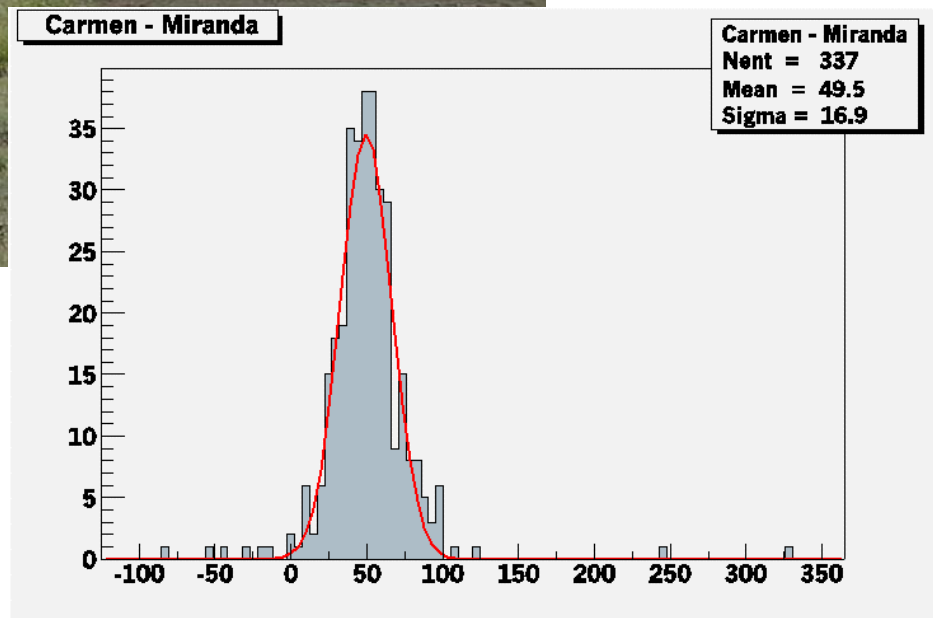
Engineering Array Events



PIERRE AUGER OBSERVATORY



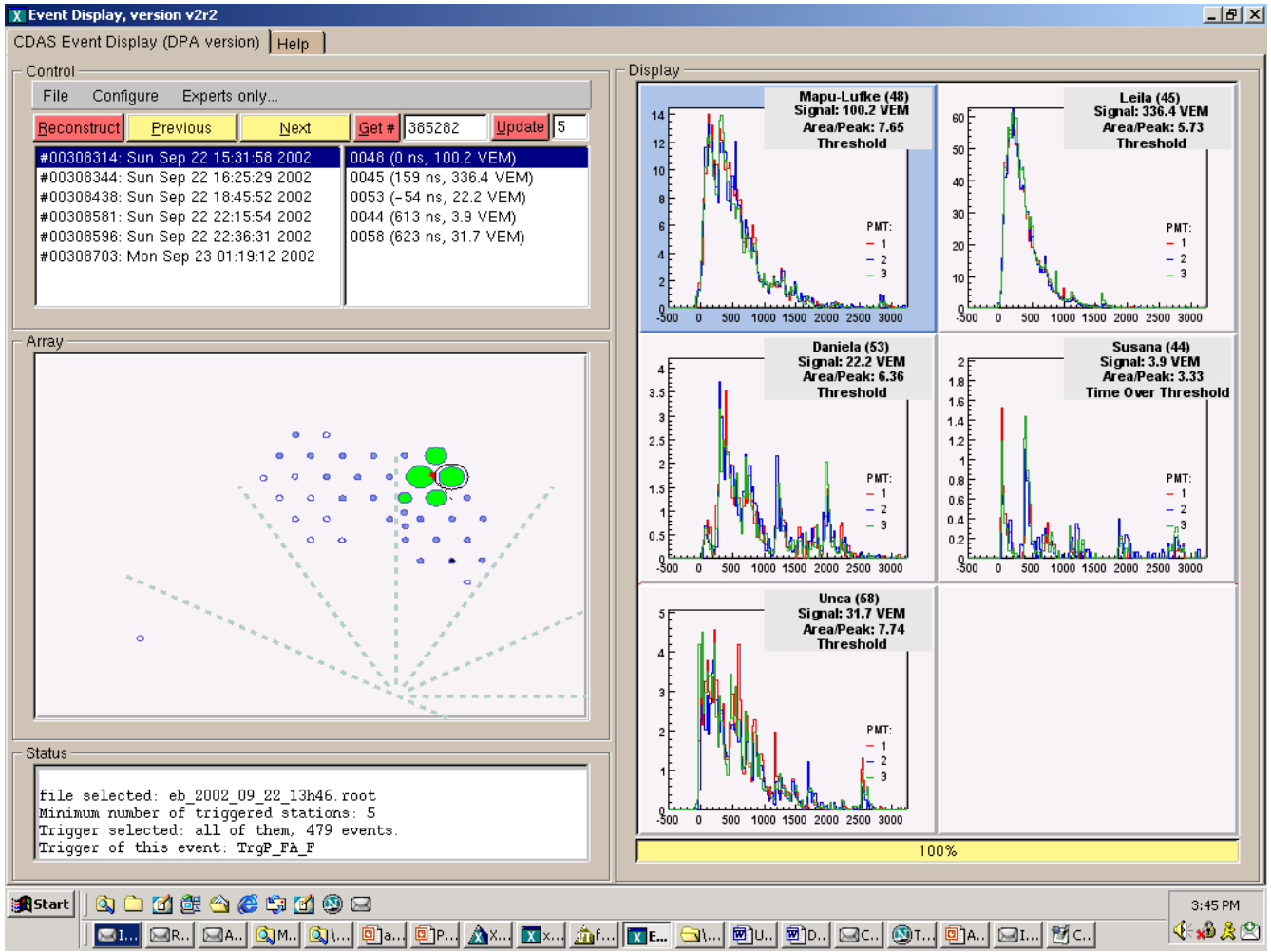
Carmen and Miranda



PIERRE AUGER OBSERVATORY

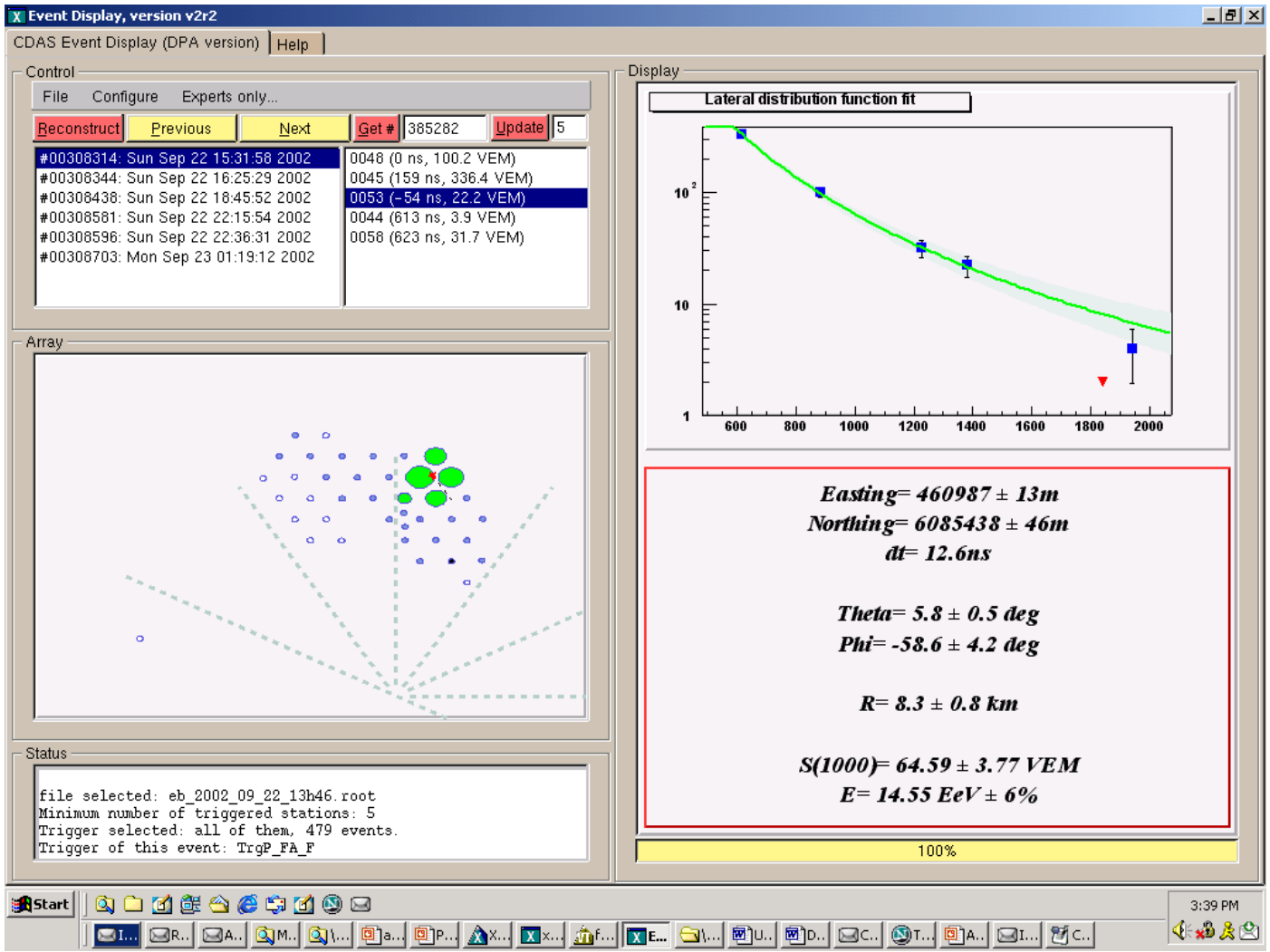
Event 308314

Zenith angle 5.8 degrees



Event 308314

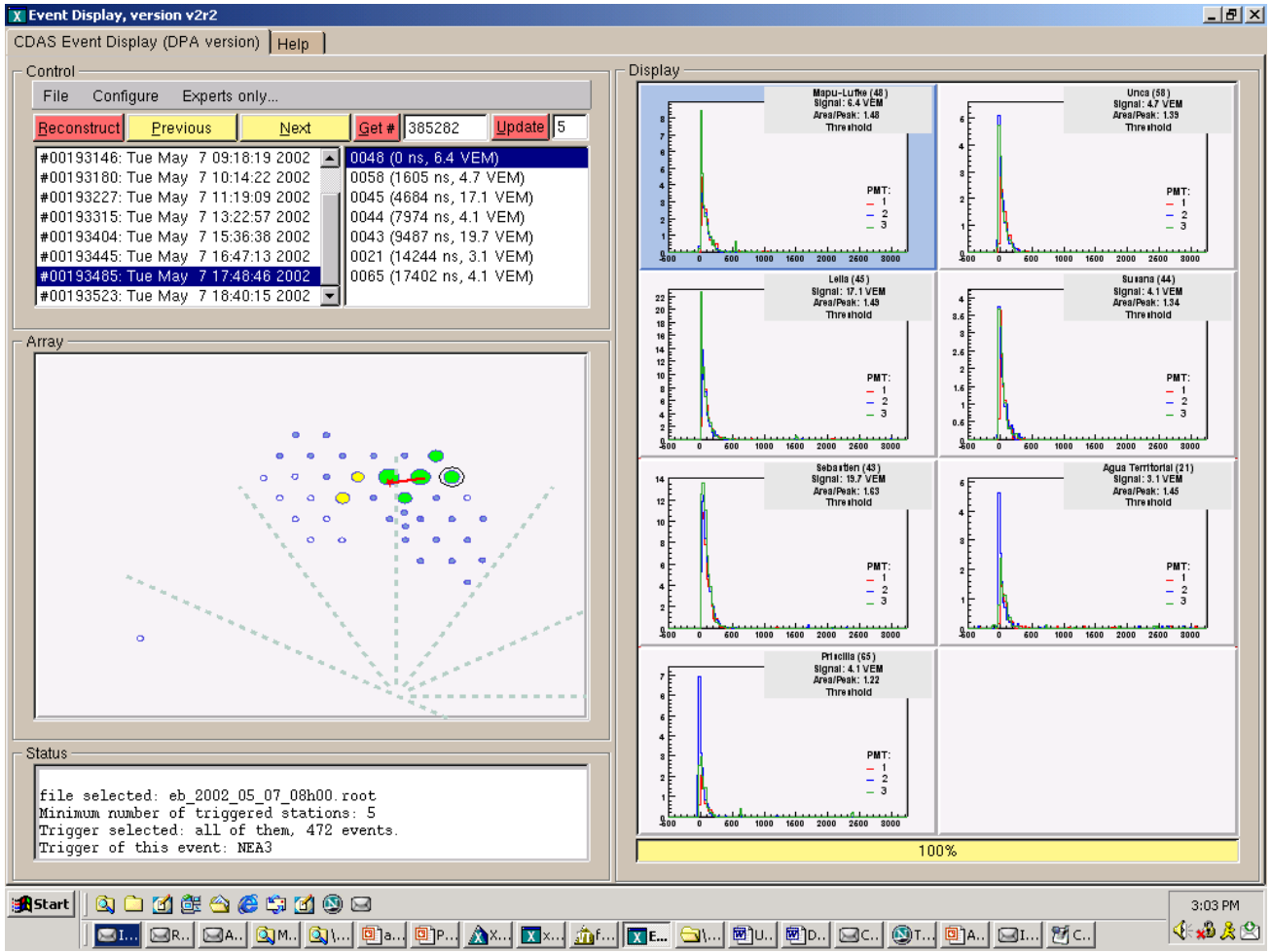
Zenith angle 5.8 degrees



PIERRE AUGER OBSERVATORY

Event 193485

Zenith angle 75.8 degrees



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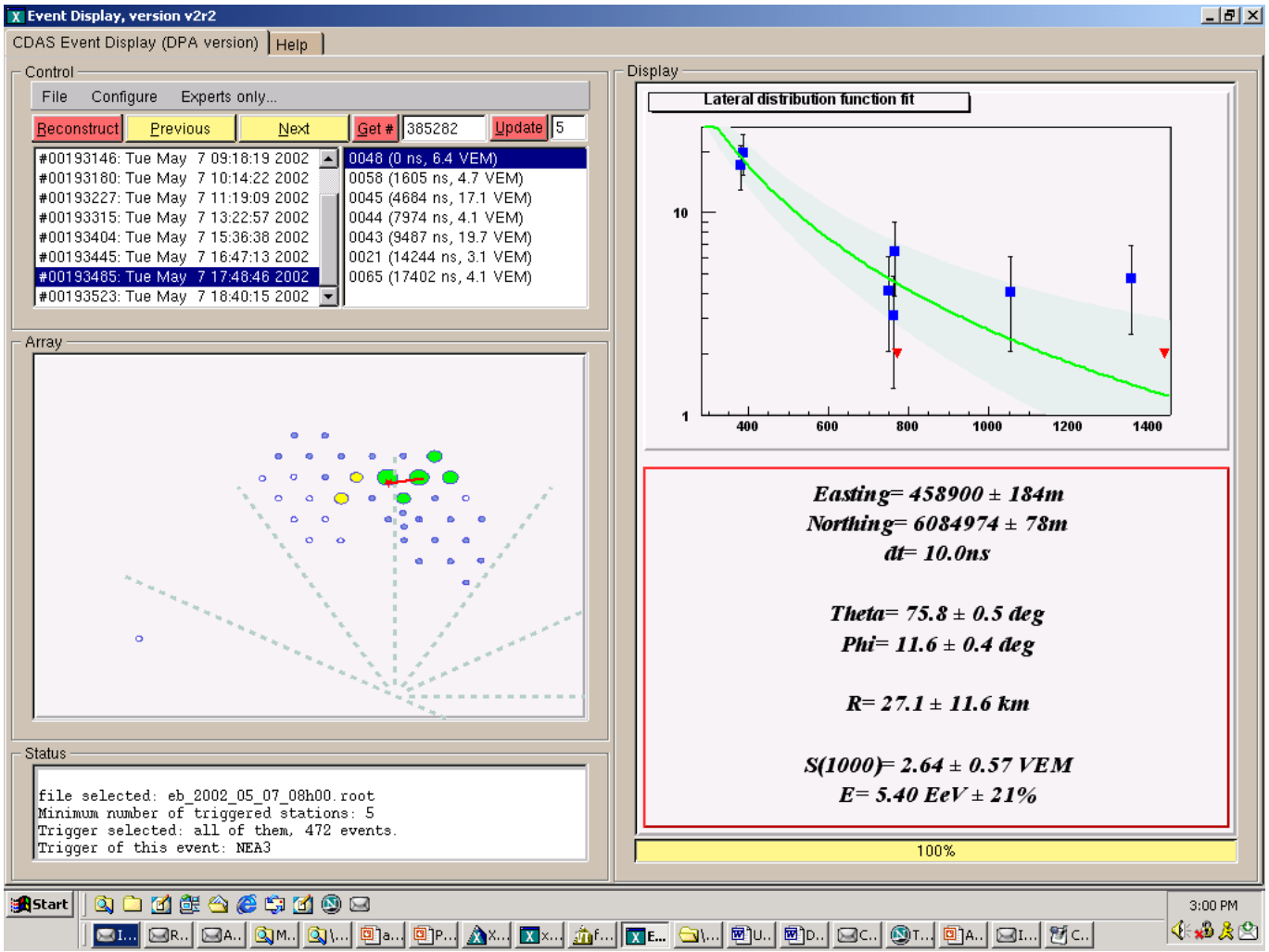
PIERRE AUGER OBSERVATORY

Event 193485

Zenith angle 75.8 degrees



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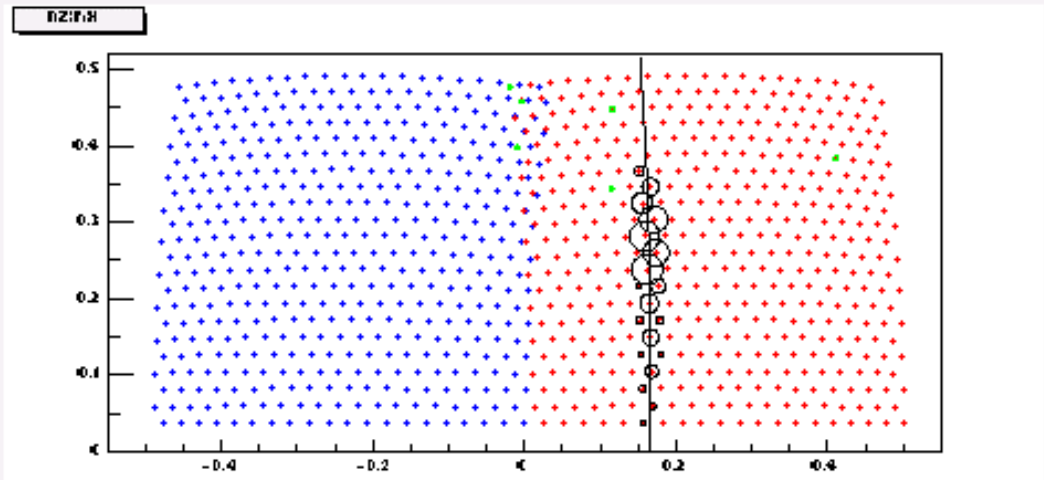
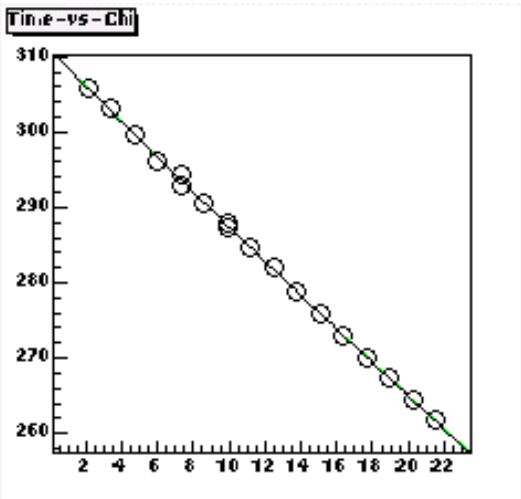
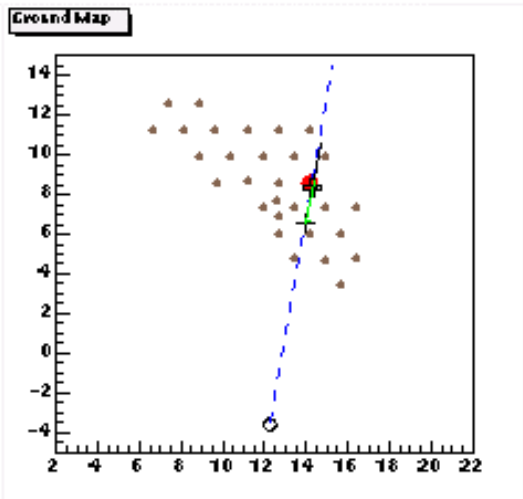
Hybrid Event

3 EeV







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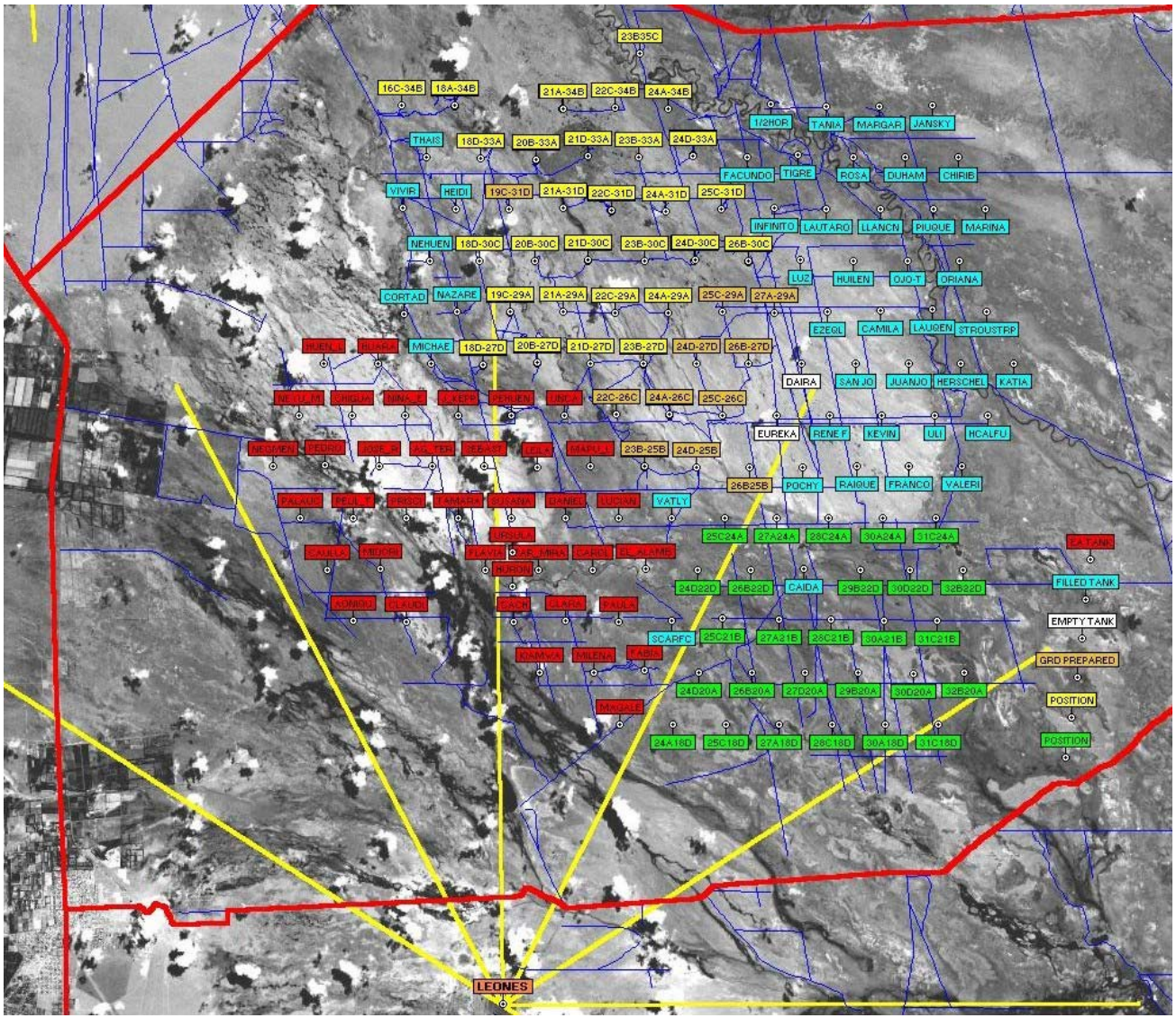
Production Deployment



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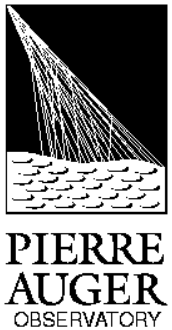
Auger at Fermilab



- **Project management office**
- **Surface detector development**
- **Surface detector electronics development**
- **Data acquisition – data mirror site**

Physicists:

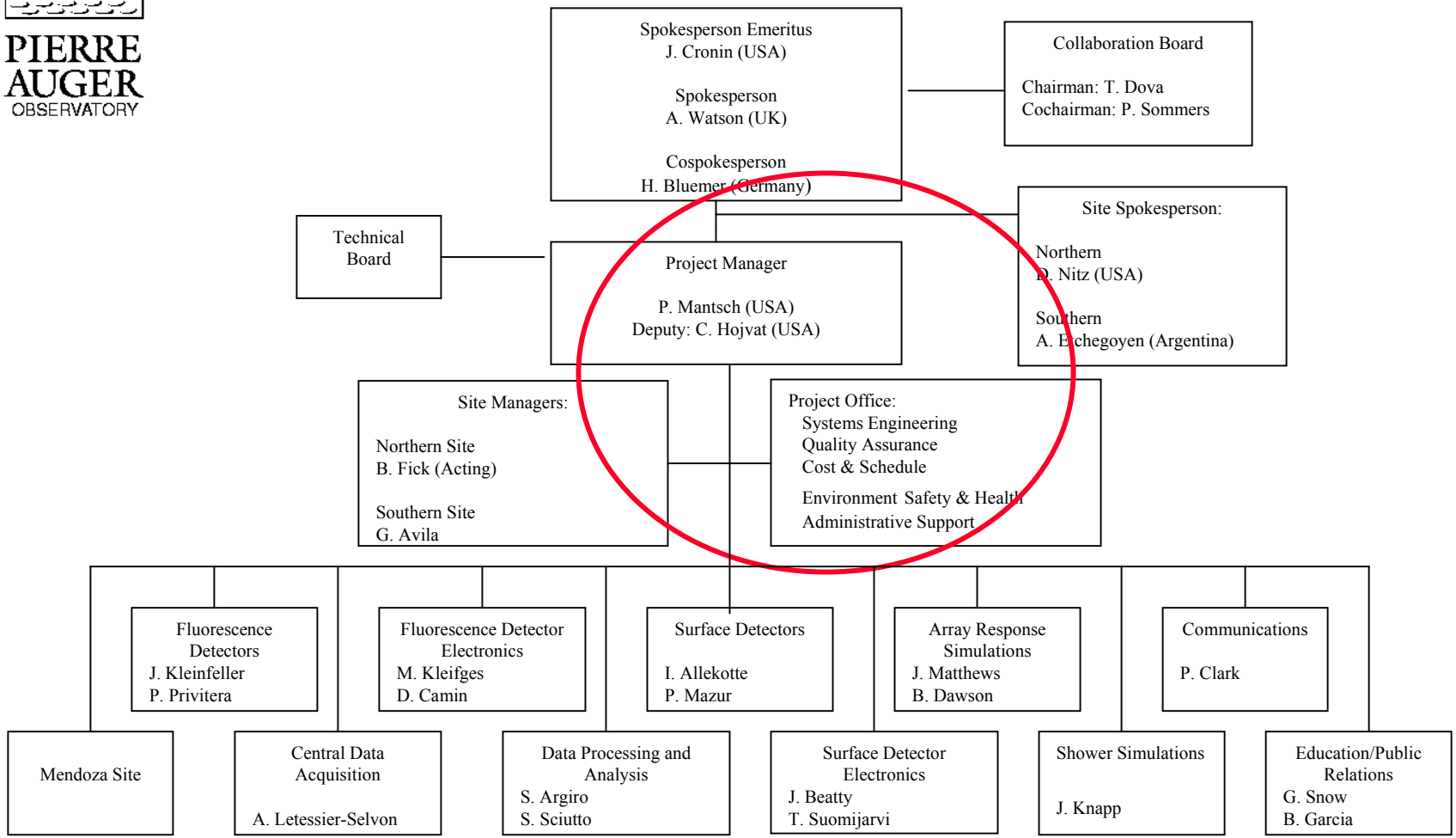
Aaron Chou (RA)
Hank Glass
Carlos Hojvat
Paul Mantsch
Cathy Newman-Holmes
Lou Voyvodic (retired)

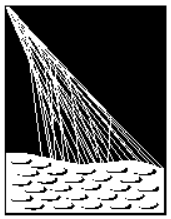
Project management staff:

Marc Kaducak – project engineer
Chez Jach – cost & schedule
Jamie Blowers – QA (part time)
Rafael Coll – ES&H (part time)
Sarah McCook - clerical

PIERRE AUGER OBSERVATORY

Management Organization





Summary

- **Exciting physics – Addresses one of the eleven science questions for the new century – NAS – "Connecting Quarks with the Cosmos".**
- **A strong collaboration.**
- **The Engineering Array is finished**
- **The detector performance exceeds original expectations.**
- **Full construction is underway.**
- **We will finish in 2005 – funding flow permitting.**